

The Relationship between Stress Levels and Biological Responses in a Clinical Nursing Practicum

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ABSTRACT

We evaluated the association between the stress levels and biological responses of nursing students in a clinical practicum. The subjects consisted of 28 third-year nursing students at the nursing department of College A. The degree of stress was evaluated using the Japanese version of the State Trait Anxiety Inventory (STAI). As parameters of biological responses, serum estrogen, salivary cortisol, and salivary IgA were measured. These measurements were performed twice (before and during the clinical practicum). Before and during the practicum, the STAI state anxiety score increased from 46.3 ± 8.1 to 52.3 ± 8.9 indicating the nursing students' practicum-associated stress. No changes were observed in the salivary cortisol or IgA level, but the serum estrogen level decreased during the practicum from 36.7 ± 14.7 to 27.0 ± 9.2 suggesting the inhibition of estrogen secretion.

Key words: *Nursing student, Clinical practicum, STAI, Stress marker*

In recent years, most people experience psychosocial stress in everyday life. Clinical practicum placements in medical worker courses have been reported to cause various forms of stress in students, increasing their anxiety^{1,4,7,10}. In the nursing education curriculum, the clinical nursing practicum plays a very important role. In the clinical practicum, students acquire practical competence by employing the knowledge and skills learned in school, but also undergo experiences which are new to them, including the ward environment and relationships, anxiety about their nursing skills and changes in lifestyle. A close relationship between anxiety in clinical practicum placements and stress has been reported⁷. However, few researchers have examined stress in the clinical practicum using objective measures such as salivary cortisol and IgA, nor, though most nursing students are female and menstrual abnormalities are characteristic, levels of serum estrogen⁵. This study includes a measurement of serum estrogen in order to provide additional quantitative data to examine objectively the association between stress and biological responses in nursing students during their practicum¹⁶.

SUBJECTS AND METHODS

Subjects

The subjects consisted of all 60 third-year students in the nursing department of College A who performed a clinical practicum in 2005. A questionnaire survey was completed by 33 students who consented to participate in this study. After excluding students who submitted an incomplete questionnaire, the questionnaires of 28 students (mean age, 21.5 ± 0.6 years) were analyzed. All 28 students were females who, according to self-reported questionnaire data, neither had health problems nor used medication habitually.

Survey methods

A lifestyle questionnaire survey, measurement following the Japanese version of the State Trait Anxiety Inventory (STAI)^{6,14} was employed as a psychological test, while salivary cortisol, IgA and serum estrogen were measured was employed as parameters of biological responses. The measurements were performed before (August-September 2005) and during (October 2005-February 2006) the clinical practicum (total, twice).

1. Lifestyle questionnaire survey

A questionnaire survey consisting of the following 11 lifestyle items associated with subjects' background and stress was performed before and during the clinical practicum: age, residential status, diet, part-time job, club activity, drinking, smoking, subjective health (students' assessment of their own health), sleep (presence or absence of sleep-associated problems), sleepiness (presence or absence of a strong feeling of sleepiness during classes or clinical practicum), and the menstrual cycle.

2. STAI

State and trait anxieties can be measured using the STAI as an anxiety measurement scale. State anxiety is a transitory emotional state affected by individual living conditions, while trait anxiety reflects an individual's characteristic responses to anxiety state experience and is a relatively stable personality tendency¹³⁾. The STAI includes 20 questions each on state and trait anxieties. Assessment is performed using a 4-grade scale (1-4), and the total score is obtained. The score is 20-80 for both state and trait anxieties. A higher score indicates more marked anxiety. Moderate tension and anxiety can actually motivate and favorably affect the growth and development of students as learning progresses. However, excessive stress induces an adverse state²⁾. Therefore, the STAI was used as a stress parameter in this study. Measurement using the STAI was performed before and during the clinical practicum to assess training-associated changes in anxiety (stress and psychological stress).

3. Serum estrogen

Focusing on menstrual abnormalities as stress responses characteristic of females, we collected blood during menstruation before and during the clinical practicum, to measure serum estrogen among female hormones. Since the estrogen level fluctuates during the menstrual cycle, blood was collected once within 3 days after the onset of menstruation. The collected blood was immediately centrifuged at 3,000 rpm for 5 min and stored at -60°C . Measurement was entrusted to an examination center and performed using a DPC: Estradiol kit.

4. Salivary cortisol and IgA

Stress increases salivary cortisol and reduces salivary IgA. Salivary cortisol and IgA levels were measured during menstruation before and during the clinical practicum. Saliva was collected after gargling using a SalivetteTM (Sarstedt) between 4 and 6 pm, when the influence of the intraday variation of cortisol secretion is only slight. Blood samples were immediately cooled, centrifuged at 3,000 rpm for 15 min, and stored at -60°C . Salivary cortisol was measured using a Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics), and salivary IgA was measured using an immuno-

globulin kit, EIA:IgA test (MBL).

Analysis methods

For the lifestyle survey, response data were quantified and summated as basic numerical totals for each item. Differences in the STAI score, serum estrogen level (pg/dl), salivary cortisol level ($\mu\text{g}/\text{dl}$), and salivary IgA level ($\mu\text{g}/\text{ml}$) between before and during the clinical practicum were analyzed by the paired t-test and Wilcoxon's test. SPSS.Ver.11.5 was used as statistical software, and $p < 0.05$ was regarded as significant.

Ethical considerations

The content and method of the study were explained to the participants in advance, and they gave their written informed consent. The study was conducted in accordance with the Declaration of Helsinki and was approved by the ethical committee of the Department of Health, Fujita Health University (#07-140).

RESULTS

1. Comparison in lifestyle between before and during the clinical practicum

The lifestyle data of subjects are shown in Table 1.

No significant difference was observed in "residential status", "meals", "smoking", "difficulty in sleeping", and "strong feeling of sleepiness" between before and during the clinical practicum.

Before the clinical practicum, a part-time job was "present" in 13 students (46.4%) and "absent" in the other 15 (53.6%). The mean frequency of part-time work was 2.4 times/week, with a mean time of 29.4 hours/week. During the clinical practicum, a part-time job was "present" in 7 students (25.0%) and "absent" in 21 (75.0%). Since some students had quit their part-time job, the mean frequency of part-time work decreased to 0.9 times/week, and its mean time to 9.3 hours/week.

Before the practicum, 10 students (35.7%) belonged to "sport clubs", while 4 (14.3%) belonged to "cultural clubs". The other 14 students (50.0%) belonged to "no club". The mean frequency of club activity was 1.4 times/week, with a mean activity time of 4.9 hours/week. During the clinical practicum, 7 students (25.0%) belonged to "sport clubs", 7 (25.0%) to "cultural clubs", and the other 14 (50.0%) to "no club". The mean frequency of club activity decreased to 0.8 times/week, and the mean activity time to 1.3 hours/week.

Concerning subjective health, before the clinical practicum, "I am in good health." was chosen by 3 students (10.7%), "I am in fairly good health." by 21 (75.0%), "I am in rather poor health." by 4 (14.3%), and "I am in poor health." by none. During the clinical practicum, "I am in good health." was chosen by 1 student (3.5%), "I

Table 1. Comparison of lifestyle between before and during clinical practicum (n=28)

Background	Before training		During training	
	n	%	n	%
Residential status				
Living alone	16	57.2	16	57.2
Living with family	10	35.7	10	35.7
Others (living with friends)	2	7.1	2	7.1
Meals				
Cook my own meals	18	64.3	17	60.7
Others cook my meals	10	35.7	10	35.7
Others (ready-prepared meals/eating out)	0	0	1	3.6
Part-time job				
Yes	13	46.4	7	25.0
No	15	53.6	21	75.0
Mean frequency of part-time job (times/week)	2.4 times		0.9 times	
Mean time (hours/week)	29.4 hours		9.3 hours	
Club activity				
Sports club	10	35.7	7	25.0
Cultural club	4	14.3	7	25.0
No club	14	50.0	14	50.0
Mean frequency of club activity (times/week)	1.4 times		0.8 times	
Mean time (hours/week)	4.9 hours		1.3 hours	
Drinking alcohol				
Almost every day	0	0	0	0
1-4 times/week	6	21.4	2	7.1
≤ 2-3 times/month	17	60.7	16	57.2
No drinking	5	17.9	10	35.7
Subjective health				
Good	3	10.7	1	3.5
Fairly good	21	75.0	15	53.6
Rather poor	4	14.3	12	42.9
Poor	0	0	0	0
Difficulty in sleeping				
Yes	9	32.1	11	39.3
No	19	67.9	17	60.7
Strong feeling of sleepiness (during classes and clinical training)				
≥ 3 times/week	10	35.7	11	39.3
1-2 times/week	5	17.9	5	17.9
Sometimes	12	42.9	10	35.7
Absent	1	3.5	2	7.1
Menstrual cycle				
Regular	23	82.1	16	57.1
Irregular	5	17.9	12	42.9

am in fairly good health.” by 15 (53.6%), “I am in rather poor health.” by 12 (42.9%), and “I am in poor health.” by none. The number of students with anxiety about their own health was significantly higher during than before the practicum ($p < 0.05$).

The menstrual cycle was “regular” in 23 students (82.1%) and “irregular” in 5 (17.9%) before the practicum but was “regular” in 16 (57.1%) and

“irregular” in 12 (42.9%) during it. A significant difference was observed between before and during the practicum ($p < 0.05$). Concerning smoking, both before and during the practicum, 25 students (89.3%) stated “I have never smoked”. The other 3 (10.7%) replied “I have quit smoking”. Therefore, there were no smokers at the time of the questionnaire.

Table 2. Comparison of STAI between before and during clinical practicum

Item	(n=28)		p value
	Before training (mean±SD)	During training (mean±SD)	
STAI (state anxiety)	46.3±8.1	52.3±8.9	0.007 *)
STAI (trait anxiety)	46.1±8.2	48.5±9.1	0.064

(paired t test) *)p<0.05

2. Comparison of the STAI score and biological responses between before and during the clinical practicum (Table 2)

The STAI state anxiety score was significantly higher during than before the practicum ($p=0.007$). The STAI trait anxiety score was slightly higher during than before the practicum ($p=0.064$). No changes were observed in the salivary cortisol or IgA level.

The serum estrogen level was significantly lower ($p=0.006$) during (27.0 ± 9.2 pg/dl) than before the clinical practicum (36.7 ± 14.7 pg/dl) (Table 3).

DISCUSSION

1. Changes in lifestyle during the clinical practicum

During the clinical practicum, the frequency of "part-time job"/week, club activity time, frequency of drinking, and "subjective health" decreased. These results suggest that time spent for leisure, hobbies, and amusements decreased compared with the period before the clinical practicum due to practicum preparation, homework, and report writing, which reduced time for recreation. The period before the clinical practicum overlapped with the summer vacation. However, since the students attended intensive courses and pre-practicum guidance and performed club activities and part-time work during this period, they may not have had time to spare. Inadequate time for rest may have reduced the self-assessment of health, which is consistent with the association between a deterioration in subjective health and the absence of time to spare in daily life suggested by the health questionnaire in college students performed by Nakano⁵⁾.

Ohida et al⁸⁾ reported that the smoking rate in nurses was higher than among females in general, and that nurses started smoking when they were nursing students. However, in this study, no student had a smoking habit, and 3 students (10.7%) had quit smoking. This may be partly because

Table 3. Comparison of biological responses between before and during practicum

Item	(n=28)		p value
	Before training (mean±SD)	During training (mean±SD)	
Salivary cortisol (µg/dl)	0.115±0.069	0.115±0.058	0.978
Salivary IgA (µg/ml)	0.320±0.612	0.237±0.197	0.410
Serum estrogen (pg/dl)	36.7±14.7	27.0±9.2	0.006 *)

(paired t test) *)p<0.05

students had become aware of their future status as health professionals due to environmental changes, such as the promotion of a smoking ban on campuses and in hospitals since the enactment of the Health Promotion Law. The number of students with an irregular menstrual cycle increased during the clinical practicum. This may have been due to stress from the clinical practicum because no marked dietary changes, slimming diets, nor excessive exercise were reported during the clinical practicum.

2. Changes in the STAI score during the clinical practicum

Comparison of the STAI score between before and during the clinical practicum identified no marked changes in trait anxiety but a significant increase in state anxiety during the clinical practicum. Trait anxiety represents responses to accumulated anxiety state experience and reflects a relatively stable individual personality tendency, and, therefore, may have been only slightly affected by the clinical practicum. In contrast, since state anxiety reflects transitory emotional states affected by the environment in which individuals are placed, the elevation of this score in the present study may indicate an increase in anxiety over the clinical practicum. Sato¹²⁾ reported a further rise in the mean STAI state anxiety score during from an increased score before the clinical practicum. Iide et al³⁾ reported a high state anxiety score before the clinical practicum in many students and its decrease after the practicum. The present survey showed a general increase in state anxiety, although, due to the nature of the curriculum, the actual period of the clinical practicum varied slightly between different groups of students. There is also a possibility that the accumulation of experience through the clinical practicum reduces anxiety. However, a high state anxiety score was maintained, a possible explanation being that although the practicum lasted for an extended period, the students were constantly faced with new tasks during this time.

3. Changes in salivary cortisol and IgA and serum estrogen during the clinical practicum

No differences were observed in salivary cortisol or IgA between before and during the clinical practicum. Since these parameters more sensitively respond to acute than to chronic stress, practicum-induced stress over a long period may have produced no significant differences. Okino et al⁹⁾ measured cortisol as a stress response marker in nursing students during a clinical practicum of peri-operative nursing, but observed no changes with time. Sakamoto et al¹¹⁾ reported no changes in the salivary IgA level during a care practicum from the pre-practicum period in college students, but a significant increase after the practicum. In this study, though changes after the clinical practicum could not be evaluated because no measurement was performed, IgA levels did not increase during the practicum, a result which is consistent with the findings of Sakamoto et al. The serum estrogen level was determined on the day showing the lowest estrogen secretion during menstruation. The estrogen level was significantly lower during than before the practicum. With regard to this finding, it is known that the menstrual cycle is regulated by a complicated interaction between the diencephalon, pituitary gland, ovaries, and uterine mucosa. Gonadotropin-releasing hormone secreted by the hypothalamus of the diencephalon regulates pituitary gonadotropin secretion, controlling the periodicity and menstrual cycle. It is also known that physical and psychological stresses affect this menstrual cycle regulation function, inducing hypothalamic menstrual abnormalities¹⁷⁾. Susannah et al¹⁵⁾ reported menstrual abnormalities due to stress associated with environmental changes and daily living. Therefore, stress may have had an influence on estrogen similar to that on other hormones in this study.

CONCLUSION

We evaluated the association between stress levels and biological responses in 28 nursing students during a clinical practicum.

1. The STAI state anxiety score was significantly higher during than before the practicum, suggesting excessive anxiety due to the clinical practicum.
2. During the clinical practicum, the number of students with an irregular menstrual cycle increased, and estrogen secretion was inhibited, suggesting an association between clinical practicum-induced stress and biological responses.

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